

MATH CREATIVE GAMES: AN INTERVENTION MATERIAL IN TEACHING BASIC MATHEMATICS

Mark Christian Torres Balaaldia

markchristian.balaaldia@deped.gov.ph

Mathematics Teacher, Laguna State Polytechnic University, Santa Cruz 4009 Laguna, Philippines

Abstract

This study determined the effect of utilizing math creative games as intervention material in teaching basic mathematics of the blended students of Banca-Banca Integrated National High School S.Y. 2021-2022. The information on related literature and studies were gathered to formulate the objectives of the studies. Specifically, the information is found in books, journals, documents, published and unpublished materials like thesis, journals, and the internet.

It specifically sought to determine the level of math creative games in terms of characteristics with regards to usability, appropriateness, and usefulness; the level of math creative games in terms student engagement with regards to attention, curiosity and interest; the level of students performance in basic mathematics in terms of pre-test and post-test; significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test; and to determine the significant effect to the performance in utilizing math creative games as intervention material in teaching basic mathematics.

Findings revealed the following: (1) The level of characteristics of math creative games with regards to usability, appropriateness, and usefulness were very evident as evaluated by the respondents of the study. (2) The level of student engagement in using math creative games in terms of attention, curiosity and interest were very evident as evaluated by the respondents of the study. (3) The level of students' performance in using intervention material in teaching Basic mathematics in terms of pre-test and post-test of the respondents resulted that from Approaching Proficient to Proficient after they use the Math Creative Games as intervention materials. (4) The test of the difference between the pre-test and post-test of the respondents resulted that there is a significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic Mathematics in pre-test and post-test. This implies that there is a significant improvement in students' basic mathematical abilities. (5) The test of significant effect to the performance in utilizing math creative games as intervention material in teaching basic Mathematics was not observed to have any significant effect to the performance of the students based on the characteristics of the games and the indicators under the students' engagement.

The research hypothesis "There is no significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test" was rejected. While research hypothesis "There is no significant effect on utilizing math creative games as intervention material in teaching basic mathematics to the blended students." was accepted.

Keywords: Math Creative Games, Usability, Appropriateness, Usefulness, Student Engagement, Attention, Curiosity, Interest, Performance.

1. Main Text

Introduction

Learning Mathematics is like building a house. In building a house, you need a strong foundation to withstand all the possible disaster and risk that the nature throws to it, just like in learning Mathematics. One needs to have a strong foundation in order to learn and solve more advanced and difficult mathematical problems that he may encounter in his school life. Basic mathematical concepts are essentials because someone will be having an easier time to solve mathematical problems if he had mastered the basic mathematical concepts.

In 2018, the Filipino learners were ranked second to the last out of the seventy-nine (79) country when it comes to Mathematics according to the Program for International Student Assessment (PISA) of the Organization for Economic Cooperation and Development (OECD). It might be viewed that it was due to the weak mastery level of the learners when it comes to basic Mathematics concepts. In my experienced in teaching Mathematics, I've encountered learners who were didn't master

the basic mathematics concepts, as a result, we ended up reviewing those concepts which is expected that they had mastered those in their previous grade level.

In recent years, teachers all around the globe were able to think of different approach in teaching Mathematics, some included the use of technology to it. Teachers saw technology as their motivational trigger and attention grabber so that the students will focus on the lesson at the same time, enjoy their time while learning took place because students nowadays were inclined on using technology rather than the traditional paper and pencil test and activities.

The use of technology in learning were used in different ways like games. It is a good substitute to a traditional quiz to make the class more interesting and exciting. It makes the learners competitive to one another as they try to score more than their classmates and makes the classroom lively and make the learners have fun while learning at the same time.

Background of the Study

Mathematics is a unique subject were in students need to take the fundamental concepts and facts first that will help them to understand more complex mathematical problems or higher level of Mathematics. In my past years teaching in the Department of Education as a Mathematics teacher, I noticed that most of the students doesn't have the mastery of the basic concepts and facts in Mathematics that is why they tend to have difficulty in understanding the lessons. Sometimes, I have to discussed the basic concepts and facts in Mathematics before my main topic so that my students will not be left behind and to make sure that in some point, they will understand the lesson by refreshing their minds about the basic concepts and facts that they should master in their previous grade level.

As cited by Tan D. A. (2018), et al, the result of the Third International Mathematics and Science Study (TIMMS) ranked the Philippines as 39th out of 41 participating international countries. This shows that Filipino students could not go beyond simple recall. They cannot fully comprehend the questions thus leading to a wrong answer.

The lack of fluency in basic mathematics ignites the minds of the teacher to create different interventions to deal with it. As cited by Letwinsky, K.M. 2017, et. al, some believe that the traditional way is more effective in developing automaticity of math facts, others believed that using the advancement in technology that introduced new approaches in teaching and learning of Mathematics in promoting automaticity in math facts. The infusion of technology to promote automaticity may be more motivating and have positive outcomes. In this research, the researcher will use another intervention on how to increase the mastery level of blended students in basic math by using the appsgyzer. The researcher will look the effect of utilizing the math creative games as intervention materials in teaching basic Mathematics.

Theoretical Framework

Theories are careful explanation which covers the known facts. These are explanations offered as possibly but not true possibly true. The study is anchored to the following theories and can help to analyze the variables related to this study thus, relate them to each other.

The researcher emphasized the importance of basic Mathematics concepts and the use of games as intervention materials on teaching it. Thorndike, one major behaviorist theorist, put forward that (1) a response to a stimulus is reinforced when followed by a positive rewarding effect, and (2) a response to a stimulus becomes stronger by exercise and repetition. While, John Dewey (1859-1952), a well-known educational psychologist, believed that practicing is a foundation of learning, and without learning practice, students would get lost. He stressed that students construct their knowledge in practice, and instructional design should respect students' psychological development needs.

Theory of Diffusion of Innovations by E.M. Rogers in 1962 as cited by Ouyang J. R. 2014, explains the model of receiving every innovation. The theory of diffusion of innovation describes the steps of technology innovation, process and characteristics of accepting new technologies, as well as receivers' role in the receiving process of technological innovation.

Another theoretical foundation related on integration of technology as intervention materials in teaching basic mathematics concepts is the TPACK framework develop by Punya Mishra and Matthew J. Koehler's (2006). The TPACK framework outlines how content (what is being taught) and pedagogy (how the teacher imparts that content) must form the foundation for any effective ed-tech integration. This order is important because the technology being implemented must communicate the content and support the pedagogy in order to enhance students' learning experience. According to the TPACK framework, specific technological tools (hardware, software, applications, associated information literacy practices, etc.) are best used to instruct and guide students toward a better, more robust understanding of the subject matter.

Statement of the Problem

The purpose of this study was to determine the effect of utilizing math creative games as intervention material in teaching basic mathematics of the blended students of Banca-Banca Integrated National High School S.Y. 2021-2022. Specifically, it sought to answer the following questions:

1. What is the level of math creative games in terms of characteristics

with regards to:

- 1.1 Usability;
- 1.2 Appropriateness; and
- 1.3 Usefulness?
2. What is the level of math creative games in terms of students engagement with regards to:
 - 2.1 Attention;
 - 2.2 Curiosity; and
 - 2.3 Interest?
3. What is the level of students' performance in Basic Mathematics in terms of:
 - 3.1 pre-test; and
 - 3.2 post-test?
4. Is there significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test?
5. Is there significant effect to the performance in utilizing math creative games as intervention material in teaching basic mathematics?

Research Methodology

This research explores the effectiveness of Math Creative Games. Specifically, it addressed the effectiveness of using Math Creative Games as intervention material in teaching basic Mathematics on the learners' performance.

Research Design

The quasi-experimental quantitative research approach was used in this study to determine the effect of utilizing Math Creative Games as an intervention material in teaching basic mathematics on the blended students of Banca-Banca Integrated National High School S.Y.2021-2022. In quasi experimental design, the researcher has limited leverage and control over the selection of study participants. Specifically, in quasi-experiments, the researcher does not have the ability to randomly assign the participants and/or ensure that the sample selected is as homogeneous as desirable.

This research design is appropriate for this topic since the researchers will gather data using a pre- and post-test. In a pretest-posttest design, the dependent variable is measured twice: once before and after the treatment is implemented. The obtained data will then be compared if there is a substantial discrepancy between the two. Choueiry (2021) went on to say that the results of the pre- and post-intervention measures are compared to see how the independent variable affects the dependent variable.

Specifically, the study utilized the quasi-experimental research design to gather the required primary data on the homogenous group that undergone a pre-examination or initial test and a post-examination or final test both containing mathematical concepts and exercises. Applying the pretest-posttest design in this research is the right approach as the score results collected from the initial and final test would be the primary data that was compared in the final procedure. Using a quasi-experimental research design allows the researcher to manipulate the independent variable as well as the treatment and the conditions that the participants are assigned to before measuring the dependent variable.

Population and Sampling Technique

The sample of the study was the blended students of the Banca-Banca National High School Victoria Laguna, S.Y. 2021-2022. The sample was done by using purposive sampling technique.

The sampling units were selected subjectively by the researcher, who attempts to obtain a sample that appears to be representative of the population. The chance that a particular sampling unit will be selected as the sample depends upon the subjective judgment of the researcher.

Research Procedure

The researcher provides titles and one of this was approved by her professor. After the professor pick and give a title that was approved. The researcher begins to conduct and construct his research. This research is all about " Math Creative Games: An Intervention Material in Teaching Basic Mathematics. This is also limited on selected topics that the learners must mastered on their lower years, such as signs, exponents, and integers. The researcher started with the Chapter 1 entitled The Problem and Its Background with a content of the introduction, background of the study, theoretical framework, conceptual framework, statement of the problem, hypothesis, and significance of the study, scope and limitation and definition of terms. This was followed by the Chapter 2 which called the Review Related Literature which contains six readings for related literature and six readings for related studies for each indicator and variable. The third Chapter Research Methodology which includes research design, respondents, research instrument, sampling techniques and the statistical treatment.

Research Instrument

The proponent utilized the **Scoring Scale** and the Equivalent to rate the respondents’ scores from 0 to 40, with 40 as the highest score. The percentage score used to differentiate between Beginning, Developing, Approaching Proficient, Proficient and Advanced. Each level is accompanied by a criterion, or set of criteria, that specifies what is needed to reach that level of quality.

Raw score	Percentage score	Descriptive Rating	Interpretation
0-8	74% and below	Beginning	Very low
9-16	75% - 79%	Developing	Low
17-24	80% - 84%	Approaching Proficient	Moderate
25-32	85% - 89%	Proficient	High
33-40	90% and above	Advanced	Very high

The proponent utilized the **Numerical Rating** and the Equivalent to rate the respondents’ perception from 1 to 5, with 5 as the highest rating. The levels (or scale) used to differentiate between Very High, High, Moderately High, Low and Very Low. Each level is accompanied by a criterion, or set of criteria, that specifies what is needed to reach that level of quality.

Rating score	Descriptive Rating	Remarks	Verbal Interpretation
4.21-5.00	Always	Very Evident	Very High
3.41-4.20	Often	Evident	High
2.61-3.40	Sometimes	Moderately Evident	Moderately High
1.81-2.60	Rarely	Somewhat Evident	Low
1.00-1.80	Never	Not Evident	Very Low

The proponent utilized the **Numerical Rating** and the Equivalent to rate the respondents’ perception from 1 to 5, with 5 as the highest rating. The levels (or scale) used to differentiate between Very High, High, Moderately High, Low and Very Low. Each level is accompanied by a criterion, or set of criteria, that specifies what is needed to reach that level of quality.

Rating score	Descriptive Rating	Remarks	Verbal Interpretation
4.21-5.00	Always	Strongly Agree	Very High
3.41-4.20	Often	Agree	High
2.61-3.40	Sometimes	Somewhat Disagree	Moderately High
1.81-2.60	Rarely	Disagree	Low
1.00-1.80	Never	Strongly Disagree	Very Low

Statistical Treatment of Data

Statistical treatment of data of the present study is shown in the table below.

Statement of the Problem	Statistical Tool
To determine the level of Math Creative Games with regards to characteristics in teaching Basic Mathematics.	Mean and Standard Deviation
To determine the level of Math Creative Games with regards of student engagement in teaching Basic Mathematics.	Mean and Standard Deviation
To determine the level of students’ performance in Basic Mathematics.	Mean and Standard Deviation
To identify whether there is a significant difference between the before and after using the Math Creative Games.	T-test
To ascertain whether Math Creative Games has no significant effect on the students’ performance.	Regression Analysis

Results and Discussion

Level of Math Creative Games in terms Characteristics in teaching Basic Mathematics

The respondents assessed the level of Math Creative Games in in terms of characteristics in teaching basic Mathematics as revealed in the following table, which shows the average mean, standard deviation, and verbal interpretation.

Table 1. Level of math creative games in terms of characteristics with regards to Usability

STATEMENT	MEAN	SD	REMARKS
The games are can be used independently.	4.85	0.36	Very Evident
The games offer questions that can be easily accomplished.	4.87	0.34	Very Evident
The games serve as a tool for instruction.	4.81	0.39	Very Evident
The games can be used online/offline.	4.83	0.38	Very Evident
The games can be a substitute for printed materials as learning material.	4.85	0.36	Very Evident
Overall Mean	4.84		Very Evident

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Very Evident	Very High
4	3.41 – 4.20	Evident	High
3	2.61 – 3.40	Moderately Evident	Moderately High
2	1.81 – 2.60	Somewhat Evident	Low
1	1.00 – 1.80	Not Evident	Very Low

Overall, the level of characteristics of math creative games in terms of Usability attained a mean score of 4.84 and a standard deviation of 0.17 and was verbally interpreted as Very High among the respondents.

It can be concluded that the used of the games as intervention materials in teaching basic Mathematics were easily accomplish and can be done independently. Moreover, it can be a substitute as learning materials on those printed materials that the teachers gave to their students. Lastly, the games can serve as tool for instruction.

As explained by Hookman, G. et al, 2016, usability is a term that is applied to describe how easy an interface is to use and might be measured directly using criteria such as: learnability (how easy a task is to learn), efficiency (how quickly tasks can be performed), reliability (how error-free tasks may be), utility (the range of tasks that can be accomplished) memorability (how easy it is to remember how to perform tasks).

Table 2. Level of math creative games in terms of characteristics with regards to Appropriateness

STATEMENT	Mean	SD	Remarks
The games are suited to the objectives of the content.	4.83	0.38	Very Evident
The games assess objectively the level of knowledge of the target learners.	4.83	0.38	Very Evident
The games contain suitable, interesting and relevant topics.	4.77	0.42	Very Evident
The games are suitable for all schools.	4.83	0.38	Very Evident
The games contain topics essential for learners of a higher level of Mathematics.	4.77	0.42	Very Evident
Overall	4.81		Very Evident

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Strongly Agree	Very High
4	3.41 – 4.20	Agree	High
3	2.61 – 3.40	Neutral	Moderately High
2	1.81 – 2.60	Disagree	Low
1	1.00 – 1.80	Strongly Disagree	Very Low

Overall, the level of characteristics of math creative games in terms of Appropriateness attained a mean score of 4.81 and a standard deviation of 0.17 and was verbally interpreted as Very High among the respondents.

It can infer that the games used as intervention materials were aligned to the objectives of this study and it can be used to assess the current level of the knowledge of the respondents. Also, it can be viewed that the games contain interesting and relevant topics which are valuable in learning higher level of mathematical concepts.

Khalil, Mohammed K. and Elkhider, Ihsan A., 2016, found out that for effective instruction, problems should be relevant, interesting, and engaging, and there should be a progression from less complex to more complex problems. In the second phase of activating previous knowledge, prior mental models or schema are activated to promote instructional effectiveness. Simply put, to avoid overwhelming students who lack foundational knowledge, provide them with relevant experience to be used as a foundation for the new knowledge.

Table 3. Level of math creative games in terms of characteristics with regards to Usefulness

STATEMENT	Mean	SD	Remarks
The games motivated me to learn more about basic Mathematics concepts.	4.85	0.36	Very Evident
The games help me to determine what I'm lacking that I need to work on.	4.81	0.39	Very Evident
The games boost my interest to learn basic Mathematics.	4.87	0.34	Very Evident
The games help me to be more attentive.	4.87	0.34	Very Evident
The games make it easier for me to understand basic Mathematics.	4.83	0.38	Very Evident
Overall	4.84		Very Evident

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Strongly Agree	Very High
4	3.41 – 4.20	Agree	High
3	2.61 – 3.40	Neutral	Moderately High
2	1.81 – 2.60	Disagree	Low
1	1.00 – 1.80	Strongly Disagree	Very Low

Overall, the level of characteristics of math creative games in terms of Usefulness attained a mean score of 4.84 and a standard deviation of 0.19 and was verbally interpreted as Very High among the respondents.

It can infer that the used of games as intervention materials in teaching basic Mathematics can boost the interest to learn basic Mathematics and help them to be more attentive. Furthermore, it can be used to determine what the respondent are lacking in regards to basic Mathematics which was good because they will know on what topics they should improve more.

As discovered by Martí-Parreño, J., Méndez-Ibáñez, E., & Alonso-Arroyo, A., 2016, another reason for using games or games elements in education is that the interactivity needed when playing a game encourages students to play an active role in the learning process, thus supporting active learning, experiential learning and problem-based learning. The use of games or games elements can also improve students' engagement and learning outcomes and can be used to tailor difficulty progression that facilitates scaffolded instruction based on each individual student's needs.

Level of Math Creative Games in terms of student engagement in teaching Basic Mathematics

The respondents assessed the level of Math Creative Games in terms of student engagement in teaching basic Mathematics as revealed in the following table, which shows the average mean, standard deviation, and verbal interpretation.

Table 4. Level of math creative games in terms of student engagement with regards to Attention

STATEMENT	MEAN	SD	REMARKS
The games encourage independence while scaling with logical concern.	4.72	0.45	Strongly Agree
The games are properly designed and well laid out.	4.70	0.46	Strongly Agree
The games contain visuals that fit the level of interest, knowledge and skills of the learners.	4.69	0.47	Strongly Agree
The games are easy to follow and answer.	4.70	0.46	Strongly Agree
The games provide sounds that use to encourage the students.	4.69	0.47	Strongly Agree
Overall Mean	4.70		Strongly Agree

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Strongly Agree	Very High
4	3.41 – 4.20	Agree	High
3	2.61 – 3.40	Somewhat Agree	Moderately High
2	1.81 – 2.60	Disagree	Low
1	1.00 – 1.80	Strongly Disagree	Very Low

Overall, the level of students' engagement in using math creative games in terms of Attention attained a mean score of 4.70 and a standard deviation of 0.21 and was interpreted Very High among the respondents.

The results show that the used of games as intervention materials in teaching basic Mathematics encourage independence and were easily to follow and answer. Moreover, it contains visuals that were suitable for the level of knowledge, skills and interest of the learners and it contains sounds that were encourage the students so that they will feel a sense of encouragement and fulfillment when they answer the questions correctly.

It was supported by the research done by Hung C. M., et al., 2014, they said that games more effectively promote academic achievement, self-efficacy, and motivation; enhance students' self-confidence; improve the speed and accuracy of mathematical calculation; and positively affect adaptive number knowledge and related arithmetic skills.

Table 5. Level of math creative games in terms of student engagement with regards to Curiosity

STATEMENT	Mean	SD	Remarks
The game's questions were not new to me which help me to not afraid of answering those questions.	4.69	0.47	Strongly Agree
The games are intrinsically motivating.	4.74	0.44	Strongly Agree
The games have some same manner questions that I have difficulty answering when I encounter it.	4.72	0.45	Strongly Agree
The games help me to have a sense of accomplishment after answering those.	4.69	0.47	Strongly Agree
The games arouse my competitiveness against myself.	4.65	0.48	Strongly Agree
Overall	4.70		Strongly Agree

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Strongly Agree	Very High
4	3.41 – 4.20	Agree	High
3	2.61 – 3.40	Somewhat Agree	Moderately High
2	1.81 – 2.60	Disagree	Low
1	1.00 – 1.80	Strongly Disagree	Very Low

Overall, the level of students' engagement in using math creative games in terms of Curiosity attained a mean score of 4.70 and a standard deviation of 0.20 and was interpreted Very High among the respondents.

The results show that the used of games as intervention materials in teaching basic Mathematics can intrinsically motivate the respondents; can used to make more competitive and boost self-confidence as they answer the questions right. Also, the games can be used to determine what are the topics which the respondent have.

As explored by Ku O., et al., 2014, numerous studies have found that digital game-based learning is effective and can create a more relaxed learning environment that promotes student engagement, interest, motivation, and confidence.

Table 6. Level of math creative games in terms of student engagement with regards to Interest

STATEMENT	Mean	SD	Remarks
I'm in charge of my learning.	4.80	0.41	Strongly Agree
The games have questions I like to work on.	4.67	0.46	Strongly Agree
The games are easy to play.	4.74	0.44	Strongly Agree
I see the games as a repetitive practice to enhance my basic mathematics skills.	4.74	0.44	Strongly Agree
The games provide opportunity to measure my basic mathematics skills.	4.72	0.45	Strongly Agree
Overall	4.73		Strongly Agree

Legend:

Scale	Range	Remarks	Verbal Interpretation
5	4.21 – 5.00	Strongly Agree	Very High
4	3.41 – 4.20	Agree	High
3	2.61 – 3.40	Somewhat Agree	Moderately High
2	1.81 – 2.60	Disagree	Low
1	1.00 – 1.80	Strongly Disagree	Very Low

Overall, the level of characteristics of math creative games in terms of Interest attained a mean score of 4.73 and a standard deviation of 0.22 and was interpreted Very High among the respondents.

The results show that the used of games as intervention materials in teaching basic Mathematics encourage independence and to play. Moreover, it contains questions which were the respondents like to work on and it can be used as learning material to practice the basic mathematics skills of the respondents.

Babiker, A., Faye, I., Mumtaz, W. et al. 2020, suggests that the interest evokes spontaneous selective allocation of attention that results in reduction of cognitive capacity and effort required for learning. For example, when someone is interested at something, they pay attention to learn and know more about it which explains the importance of attention for other cognitive

processes to occur.

Level of the Student's Performance in Basic Mathematics in terms of Pre-test and Post Test

The researcher assessed the level of the Student's Performance in basic Mathematics in terms of Pre-test as revealed in the following table, which shows the average mean, standard deviation, and verbal interpretation.

Table 7. Level of the Student's Performance in Basic Mathematics in terms of Pre-Test

Scores	Frequency	Relative Frequency	Remarks
33-40	1	1.85%	Advanced
25-32	14	25.95%	Proficient
17-24	33	61.11%	Approaching Proficient
9-16	6	11.11%	Developing
0-8	0	0%	Beginning
Total	54	100%	
Mean	21.69		Approaching Proficient
SD	4.38		

It can be gleaned from the table that most of the scores of the respondents obtained by the score 17-24 got a mean score of 21.69 and a standard deviation of 4.38 and remarked as Approaching Proficient. This means that the students, before using the math creative games already have a moderate remark on basic mathematics concepts. The students at this stage acquire a minimum level of knowledge and core understanding about the basic mathematics concepts.

Sanders, S. (2019), in her article entitle "Brief guide to selection and using pre-post assessment", said that pre-post testing can be valuable to teachers because it provides information about the status of the learnings of the students. Although, she said that pretest should not be the sole information in deciding what teaching method a teacher should use.

Table 8. Level of the Student's Performance in Basic Mathematics in terms of Post-Test

Scores	Frequency	Relative Frequency	Remarks
33-40	28	51.85%	Advanced
25-32	20	37.03%	Proficient
17-24	6	11.11%	Approaching Proficient
9-16	0	0%	Developing
0-8	0	0%	Beginning
Total	54	100%	
Mean	31.81		Proficient
SD	5.10		

It can be gleaned from the table that most of the scores of the respondents obtained by the score 33-40 got a mean score of 31.81 and a standard deviation of 5.10 and remarked as Proficient. This means that the students, after using the math creative games they have a high remark on basic mathematics concepts. The students developed their level of their understanding on the basic mathematical concepts which will be key in learning advanced mathematical concepts.

Aleson-Carbonell, & Guilen-Nieto (2012) discussed the importance of games in education is indisputable as the potential advantage of utilizing instructive recreations to supplement customary classroom direction are certain.

Significant Difference of the Students' Performance in Basic Mathematics in terms of Pre-Test and Post Test upon using the Math Creative Games

Shows the difference of the Students' Performance in Basic Mathematics in terms of Pre-Test and Post Test upon using the Math Creative Games. The data were statistically treated using Paired t-test. The following shows estimation for mean, mean difference, standard deviation, p-value, and its analysis.

Table 9. Test of Difference in the Performance of the Students in Utilizing Math Creative Games as Intervention Material in Teaching Basic Mathematics in Pre-test and Post-test

Variables	Mean	Mean Difference	Computed t-value	p-value	Critical t-value	Analysis
Pre-test	21.69	10.12	17.904	0.000	2.006	Significant
Post-test	31.81					
$\alpha = 0.05$						

The test of the difference between the pre-test and post-test of students on basic mathematics shows a computed value of (t-value= 17.904; $p < .05$) interpreted as Significant.

Based on the data, it is shown that there is a significant difference between the Students performance of the blended students in pre-test and post test scores in using the Math Creative Games at 0.05 level of significance. It shows that there is a significant difference between the pre-test and post-test of utilizing Math Creative Games as intervention materials in teaching basic Mathematics. Hence, the hypothesis, there is no significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test was rejected.

As concluded by Deng L., et al., 2019, Game-based learning allowed the teacher to break free of the lecture-based class structure, creating more time for independent exploration and thinking. Students also interacted, communicated, and collaborated more with their peers and teacher. In this more relaxed environment, students enjoyed decreased workloads and evolved from being passive receivers to active thinkers.

Significant Effect of Math Creative Games in Teaching Basic Mathematics

Shows the effect of Math Creative Games in Teaching Basic Mathematics. The data were statistically treated using Regression Analysis. The following shows estimation for mean, mean difference, standard deviation, beta coefficient, f-value, p-value and its analysis.

Table 10. Test on the Significant Effect on the Performance in Utilizing Math Creative Games as Intervention Material in Teaching Basic Mathematics.

Math Creative Games		Beta coefficient	F-value	p-value	Analysis
Usability	Learners' Performance	.265	1.74	.088	Not Significant
Appropriateness		-.087	-0.54	.592	Not Significant
Usefulness		.044	.230	.819	Not Significant
Attention		.039	.261	.795	Not Significant
Curiosity		-.063	-.385	.702	Not Significant
Interest		-.017	-.092	.927	Not Significant
$\alpha = 0.05$					

The Math Creative Games was not observed to have any significant effect to the performance of the students based on the characteristics of the games and the indicators under the students' engagement. This is suggested from the computed p-values for all tests which were greater than the significance alpha 0.05, hence the absence of a significant result. From the findings above, it can be inferred that at 0.05 level of significance, the null hypothesis "There is no significant effect on utilizing math creative games as intervention material in teaching basic mathematics to the blended students" is true. Hence, there is no significant effect.

Furthermore, even though there was an increased on the scores on the post-test of the respondents, based on the results, it can be gleaned that the characteristics of the games doesn't have effect on the learning of the students. It might be there are some factors that contribute to their learning.

Yun-Jo An, et. al., (2016) on their research entitled "using educational computer games in the classroom: science teachers' experiences, attitudes, perceptions, concerns, and support need", found out that teachers mostly uses short-form games, such as drill and practice games and jeopardy style review games. Drill and practice games help students memorize simple facts and develop basic skills, they are not effective for teaching complex content and higher-level skills. They also suggest that the teachers should integrate more activities that provides opportunities to explore good games designed to help students develop 21st century skills beyond drill and practice games and simulations.

Summary of Findings

This chapter includes the presentation of a summary, findings, conclusion based on the hypothesis, and the corresponding recommendations.

Summary

The focal purpose of this study was to determine the effect of utilizing math creative games as intervention material in teaching basic mathematics of the blended students of Banca-Banca Integrated National High School S.Y. 2021-2022.

It specifically sought to determine the level of math creative games in terms of characteristics with regards to usability, appropriateness, and usefulness; the level of math creative games in terms student engagement with regards to attention, curiosity and interest; the level of students performance in basic mathematics in terms of pre-test and post-test; significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test; and to determine the significant effect to the performance in utilizing math creative games as intervention material in teaching basic mathematics.

The quasi-experimental quantitative research approach was used in this study to determine the effect of utilizing Math Creative Games as an intervention material in teaching basic mathematics on the blended students of Banca-Banca Integrated National High School S.Y.2021-2022.

Based on the gathered data, the findings of this study were the following:

1. Level of Math Creative Games with regards to Characteristics in teaching Basic Mathematics.

The respondents of the study evaluated the Math Creative Games with regards to its characteristics as very evident. Students views that Math Creative Games can offer questions that can be easily accomplished; suited to the objectives of the content, assess objectively the level of knowledge of the target learners; were suitable for all schools and can boost their interest to learn basic Mathematics.

2. Level of Math Creative Games with regards to Student Engagement in teaching Basic Mathematics.

The respondents of the study evaluated the Math Creative Games with regards to student engagement as very evident. Students views that Math Creative Games can encourage independence while scaling with logical concern; were intrinsically motivating and they were in-charge of their learning.

3. Level of students' performance in Basic Mathematics

It was shown that most of the scores of the respondents obtained by the score 17-24 got a mean score of 21.69 and a standard deviation of 4.38 and remarked as Approaching Proficient. This means that the students, before using the math creative games already have a moderate remark on basic mathematics concepts.

Most of the scores of the respondents obtained by the score 33-40 got a mean score of 31.81 and a standard deviation of 5.10 and remarked as Proficient. This means that the students, after using the math creative games they have a high remark on basic mathematics concepts. The students developed their level of their understanding on the basic mathematical concepts which will be key in learning advanced mathematical concepts.

4. Significant Difference of the Students' Performance in Basic Mathematics in terms of Pre-Test and Post Test upon using Math Creative Games

It is shown that there is a significant difference between the Students performance of the blended students in pre-test and post test scores in using the Math Creative Games at 0.05 level of significance. It shows that there is a significant difference between the pre-test and post-test of utilizing Math Creative Games as intervention materials in teaching basic Mathematics.

5. Significant Effect of Math Creative Games in Teaching Basic Mathematics in terms of Post Test.

The Math Creative Games was not observed to have any significant effect to the performance of the students based on the characteristics of the games and the indicators under the students' engagement. This is suggested from the computed p-values for all tests which were greater than the significance alpha 0.05, hence the absence of a significant result.

From the findings above, it can be inferred that at 0.05 level of significance, the null hypothesis "There is no significant effect on utilizing math creative games as intervention material in teaching basic mathematics to the blended students" is true. Hence, there is no significant effect.

Conclusion

Based on the finding of the study, the following conclusions were drawn:

The hypothesis stating that "There is no significant difference in the performance of the students in utilizing math creative games as intervention material in teaching basic mathematics in pre-test and post-test" was rejected. While the

hypothesis stating that “There is no significant effect on utilizing math creative games as intervention material in teaching basic mathematics to the blended students.” was accepted.

Recommendations

Based on the results and conclusion posted in the study, the following recommendation was formulated to the following.

1. It is highly recommended that the Math Creative Games maybe use as intervention materials in teaching basic Mathematics as the results shows it can enhance the knowledge of the respondents on basic Mathematics.
2. It is suggested for teachers to develop more gamified intervention materials that could help them in uplifting the knowledge of the students. They can also explore other platforms and open other possibilities for innovation of other interactive learning materials.
3. Also, the Department of Education can share the result of this study to the teachers in the education field for an innovative learning. They can view the results of this study as evidence that gamified can be used in teaching which can enhance students’ knowledge and make teaching more fun and interesting. Also, they can use the materials used in this study to increase the numeracy skills of the learners.
4. Lastly, other researchers can use this study to help them further analyze and improve the use of gamified instructional materials in teaching.

References

- Agno, Lydia N. Ph D. (2014) Principles of Teaching |: A Modular Approach Quezon City: C & E Publishing Inc.
- Alcantara, M. A. 2015, INTEGPHLET: AN AID FOR BETTER UNDERSTANDING ON INTEGERS
- Aleson-Carbonell, M., & Guillen-Nieto, V. 2012. Serious games and learning effectiveness: the case of its deal!. *Computers & Education*, 58(1), 435-448. <https://dx.doi.org/10.1016/j.compedu.2011.07.015>
- Antonio Sánchez-Mena, José Martí-Parreño & Joaquín Aldás-Manzano (2018): Teachers’ intention to use educational video games: The moderating role of gender and age, *Innovations in Education and Teaching International*, DOI: 10.1080/14703297.2018.1433547
- Babiker, A., Faye, I., Mumtaz, W. et al. EEG in classroom: EMD features to detect situational interest of students during learning. *Multimed Tools Appl* 78, 16261–16281 (2019). <https://doi.org/10.1007/s11042-018-7016-z>
- Baltazar, Errol. Validation and Effectiveness of Multimedia Instructional Materials in Teaching Math in San Isidro Elementary School. 2015
- Baltazar Joey. Module: Systems of Linear Equations in Two Variables. 2015
- Bevan, N., Carter, J., Earthy, J., Geis, T., Harker, S. (2016). New ISO Standards for Usability, Usability Reports and Usability Measures. In: Kurosu, M. (eds) *Human-Computer Interaction. Theory, Design, Development and Practice. HCI 2016. Lecture Notes in Computer Science*, vol 9731. Springer, Cham.
- Birbarium Pierce, L.G. & Salas, E., (2013), *Understanding Adaptability: A Prerequisite for Effective Performance within Complex*, British Library Cataloguing in Publication Data.
- Blake C., 2020. *Timing is Everything: Using Short Student Attention Spans to Your Advantage in the Classroom*
- Bradbury, N. A. (2016). Attention span during lectures: 8 seconds, 10 minutes, or more? *Advances in Physiology Education*, 40(4), 509–513. doi:10.1152/advan.00109.2016
- Capuno, R. et al., 2019. Attitudes, Study Habits, and Academic Performance of Junior High School Students in Mathematics. *INTERNATIONAL ELECTRONIC JOURNAL OF MATHEMATICS EDUCATION* e-ISSN: 1306-3030. 2019, Vol. 14, No. 3, 547-561 <https://doi.org/10.29333/iejme/5768>
- Davids, M. R. 2013. An efficient approach to improve the usability of e-learning resources: the role of heuristic evaluation <https://doi.org/10.1152/advan.00043.2013>
- Debnath C. & Janet C. 2017. *How to Write Well-Defined Learning Objectives*

- Deng L, Wu S, Chen Y, Peng Z. Digital game-based learning in a Shanghai primary-school mathematics class: A case study. *J Computer Assist Learn.* 2020;1–9. <https://doi.org/10.1111/jcal.12438>
- Donald Latumahina, 2018. Four Reasons Why Curiosity Is Important and How to Develop It. <http://www.lifehack.org/articles/productivity/4-reasons-why-curiosity-is-important-and-how-to-develop-it.html>
- Ebele, U. F., & Olofu, P. A. (2017). Study habit and its impact on secondary school students' academic performance in Biology in the Federal Capital Territory, Abuja. *Educational Research and Reviews*, 12(10), 583-588. <https://doi.org/10.5897/ERR2016.3117>
- Eva A. I., 2018. How to Cultivate Curiosity in Your Classroom https://greatergood.berkeley.edu/article/item/how_to_cultivate_curiosity_in_your_classroom
- Geary, D. C., 2012. Consequences, characteristics, and causes of mathematical learning disabilities and persistent low achievement in mathematics. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3131082/#_ffn_sectitle
- Grammer J.K., 2021. What do we know about student attention in the classroom? <https://npjscilearncommunity.nature.com/posts/what-do-we-know-about-student-attention-in-the-classroom>
- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, 80, 152–161.
- Hilda Ng'etich Tuimur & Bernard Chemwei., 2015. AVAILABILITY AND USE OF INSTRUCTIONAL MATERIALS IN THE TEACHING OF CONFLICT AND CONFLICT RESOLUTION IN PRIMARY SCHOOLS IN NANDI NORTH DISTRICT, KENYA, *International Journal of Education and Practice*, 2015, 3(6): 224-234
- Holly, 2018. Pre and Post Tests. Are they beneficial in the classroom? <https://www.teachstarter.com/au/blog/pre-and-post-tests-are-they-beneficial-in-the-classroom/>
- Hookman, G. et al, 2016. Comparing Usability and Engagement between a Serious Game and a Traditional Online Program ACE '16 Canberra, ACT Australia <https://doi.org/10.1145/2843043.2843365>
- Huizenga J.C., ten Dam G.T.M., Voogt J.M. & Admiraal W.F., Teacher perceptions of the value of game-based learning in secondary education, *Computers & Education* (2017), doi: 10.1016/j.compedu.2017.03.008.
- Hung, C.-M., Huang, I., & Hwang, G.-J. (2014). Effects of digital game-based learning on students' self-efficacy, motivation, anxiety, and achievements in learning mathematics. *Journal of Computers in Education*, 1, 151–166. <https://doi.org/10.1007/s40692-014-0008-8>
- Ibe-Bassey, G. S. (2012). Educational technology: The teaching learning process and the falling standard of education in Nigeria. 35th Inaugural lecture series of the University of Uyo, Uyo, Nigeria.
- Institute of Education Sciences. (2016). Request for applications: Special education research grants. US Department of Education.
- Johannesson, M., & Lundqvist, H. 2012. Understanding Purpose and Circumstantial Context in the Use of Educational Games: designing a search function and updating a Metadata model (Masters). University of Skovde
- Judith M. Harackiewicz et. al, 2016. Interest Matters: The Importance of Promoting Interest in Education <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5839644/>
- Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education.* San Francisco, CA: Pfeiffer.

- Keller, A. S., Davidesco, I., & Tanner, K. D. (2020). Attention Matters: How Orchestrating Attention May Relate to Classroom Learning. *CBE—Life Sciences Education*, 19(3), fe5. doi:10.1187/cbe.20-05-0106
- Khalil, Mohammed K. and Elkhider, Ihsan A, 2016. Applying learning theories and instructional design models for effective instruction <https://journals.physiology.org/doi/full/10.1152/advan.00138.2015>
- Ku, O., Chen, S. Y., Wu, D. H., Lao, A. C. C., & Chan, T.-W. (2014). The effects of game-based learning on mathematical confidence and performance: High ability vs. low ability. *Journal of Educational Technology & Society*, 17(3), 65–78.
- Kubat, U. (2018). Identifying the Individual Differences Among Students During Learning and Teaching Process by Science Teachers. *International Journal of Research in Educational and Science*, (IJRES), 4(1), 30-38. DOI:10.21890/ijres.369746
- Kuehn P. R., 2021. Function and Importance of pre and post-test <https://owlcation.com/academia/PrePost-Test-A-Diagnostic-Tool-For-More-Effective-Teaching-of-EFL-Students>
- Kurniasih, H., Utari, V. Y. D., & Akhmadi. (2019). Character education policy and its implications for learning in Indonesia's education system. *RISE Insights*.
- Lamba S. et al., 2014. Impact of Teaching Time on Attention and Concentration. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 3, Issue 4 Ver. I (Jul-Aug. 2014), PP 01-04
- Levy Y. & Ellis T., 2011, A Guide for Novice Researchers on Experimental and Quasi -Experimental Studies in Information System Research https://www.researchgate.net/publication/228934334_A_Guide_for_Novice_Researchers_on_Experimental_and_Quasi-Experimental_Studies_in_Information_Systems_Research
- M. A. S. Cahyanto et al 2019 *J. Phys.: Conf. Ser.* 1397 012019 Analysis of Students' Misconception Based on the Use of Learning Objectives in Classification of Materials and Their Properties
- Martí-Parreño, J., Méndez-Ibáñez, E., & Alonso-Arroyo, A. (2016). The use of gamification in education: a bibliometric and text mining analysis. *Journal of Computer Assisted Learning*, 32(6), 663–676. doi:10.1111/jcal.12161
- Martin. H., Constructing Learning Objectives by Academic Advising. March, 2011. <http://www.nacada.ksu.edu/Resources/Clearinghouse/View-Articles/Constructing-student-learning-outcomes.aspx#sthash.5J2Rp9kU.dpuf>
- Marbas J. 2018. THE IMPORTANCE OF INSTRUCTIONAL MATERIALS https://www.academia.edu/8704377/THE_IMPORTANCE_OF_INSTRUCTIONAL_MATERIALS
- Mathematics Practice and Fluency., 2019 <https://www.3plearning.com/blog/mathematics-fluency/>
- McCarthy J. 2014. Learner Interest Matters: Strategies for Empowering Student Choice <https://www.edutopia.org/blog/differentiated-instruction-learner-interest-matters-john-mccarthy>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teachers' knowledge. *Teachers College Record*, 108 (6), 1017–1054
- Nasution, D., Harahap, P. S., & Harahap, M. (2018). Development instrument's learning of physics through scientific inquiry model-based Batak culture to improve science process skill and student's curiosity. *Journal of Physics: Conference Series*, 970(1).
- Odiri, O. E. (2015). Relationship of study habits with mathematics achievement. *Journal of Education and Practice*, 6(10), 168-170.

OpenLearnCreate, 2020. General Teaching Method: Purpose of teaching and learning materials.
<https://www.open.edu/openlearncreate/mod/page/view.php?id=168509>

Ouyang, J. R., 2014. Theories and Research in Educational Technology and Distance Learning Instruction through Blackboard
 DOI: 10.13189/ujer.2014.020208

Parker C. B., 2015. Research shows the best ways to learn math
<https://ed.stanford.edu/news/learning-math-without-fear>

Raja R., Nagasubramani P. C., 2018. Impact of modern technology in Education
https://www.researchgate.net/publication/325086709_Impact_of_modern_technology_in_education

Reinhold, F., Schons, C., Scheuerer, S., Gritzmann, P., Richter-Gebert, J., & Reiss, K. (2021). Students' coping with the self-regulatory demand of crisis-driven digitalization in university mathematics instruction: do motivational and emotional orientations make a difference? *Computers in Human Behavior*, 120, 106732. doi:10.1016/j.chb.2021.106732

Renninger, K. A., & Hidi, S. (2016). *The power of interest for motivation and engagement*. New York, NY: Routledge.

Rettie, C. 2016. Accreditation — Standard 2 Curriculum — Learning Objectives
<https://www.nppostgradtraining.com/2016/07/19/accreditation-standard-2-curriculum-learning-objectives/>

Right J., 2018. The Importance of Learning Materials in Teaching
<https://www.theclassroom.com/importance-learning-materials-teaching-6628852.html>

Roseline Olufunke Bukoye, 2019. Utilization of Instruction Materials as Tools for Effective Academic Performance of Students: Implications for Counselling

Ruef, J., 2018. Think you're bad at math? You may suffer from "math trauma"
<https://theconversation.com/think-youre-bad-at-math-you-may-suffer-from-math-trauma-104209>

Sanders, S. 2019. A Brief Guide to SELECTING AND Using Pre-Post Assessment
https://www.google.com/url?sa=t&source=web&rct=j&url=https://files.eric.ed.gov/fulltext/ED604574.pdf&ved=2ahUKEwjS0Z6P8_rwAhXlc94KHyeHAO0QFjAQegQICChAC&usq=AOvVaw36MUjsBftvfQA1IU7G2W&cshid=1622703957807

Singh A., 2020. Strategies Involving Student's Interest In Learning
<https://www.theasianschool.net/blog/strategies-involving-students-interest-in-learning/>

Sokkhey, P., & Okazaki, T. (2019). Comparative Study of Prediction Model on High School Student Performance in Mathematics. 2019 34th International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC). doi:10.1109/itc-csc.2019.8793331

Suhrman., Prayogi, S., & Asy'ari, M. (2021). Problem-Based Learning with Character Emphasis and Naturalist Intelligence: Examining Students Critical Thinking and Curiosity. *International Journal of Instruction*, 14(2), 217-232.
<https://doi.org/10.29333/iji.2021.14213a>

Syamsuddin A., et al., 2020. Mathematics Learning Interest of Students Based on the Difference in the Implementation of Model of Thematic Learning and Character-Integrated Thematic Learning. *European Journal of Educational Research* Volume 10, Issue 2, 581 - 591.

Tuch AN, Roth SP, Hornb æKK, Opwis K, Bargas-Avila JA. Is beautiful really usable? Toward understanding the relation between usability, aesthetics, and affect in HCI. *Comput Hum Behav* 28: 1596–1607, 2012.

University of Wisconsin, 2021. Design, Teach and Engage: Instructional material
<https://designteachengage.wisc.edu/instructional-materials/>

Widodo, S. A. and Wahyudin, 2018. Selection of Learning Media Mathematics for Junior School Students. *The Turkish Online Journal of Educational Technology* – January 2018, volume 17 issue 1

Wu P-H, Kuo C-Y, Wu H-K, Jen T-H, Hsu Y-S. Learning benefits of secondary school students' inquiry-related curiosity: A cross-grade comparison of the relationships among learning experiences, curiosity, engagement, and inquiry abilities. *Sci Ed.* 2018;1–34. <https://doi.org/10.1002/sce.21456>

Yañez-Gomez, R. et al (2016). Academic methods for usability evaluation of serious games: a systematic review.

Yun-Jo An, et al., 2016. Using Educational Computer Games in Classroom: Science teachers' experiences, Attitudes, Perceptions, Concerns, and Support Needs
<https://citejournal.org/volume-16/issue-4-16/science/using-educational-computer-games-in-the-classroom-science-teachers-experiences-attitudes-perceptions-concerns-and-supprt-needs/>

Vistro-Yu, C. P., 2011. Mathematics framework for the Philippine basic education.
https://www.google.com/url?sa=t&source=web&rtc+j&url=https://sei.dost.gov.ph/images/downloads/publ/sei_mathbasic.pdf&ved=2ahUKEwjh0cCc7oLxAhXsfUHHa02DGwQFjAAegQIAxAC&usg=AOvVawOPtmHEXhFQedU49uL0yEv

Walden University, 2014. Teaching Strategies: Sparking Curiosity in Learning
<https://www.waldenu.edu/online-masters-programs/ms-in-education/resource/teaching-strategies-sparking-curiosity-in-learning>

Wiseman J., 2019. 5 ways to keep students' attention in class.
<https://www.english.com/blog/5-ways-to-keep-students-attention/>

Zirawaga, V. S., et al., 2017. Gaming in Education: Using games as a Support tool to teach history. *Journal of Education and Practice*. Vol.8, No.,15
https://files.eric.ed.gov/fulltext/EJ1143830.pdf&ved=2ahUKEwjw06iP8oLxAhXQAYgKHdK6BjgQFjALegQIGBAC&usg=AOvVaw0KEI_WFqmX4V9J9cU2Mb5&cshid=1622979107572